

BIOLOGY OF THE BIDENS BORER, EPIBLEMA
OTIOSANA (CLEMENS) (LEPIDOPTERA,
OLETHREUTIDÆ)*

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AMES, IOWA

The bidens borer (*Epiblema otiosana* Clem.), a species indigenous to that portion of the United States lying east of the 100th meridian, is generally regarded as having little or no economic importance. It is, however, of considerable interest because it is an important insect enemy of a group of noxious weeds known as beggar ticks and, also, because it serves as a reservoir for important parasites of several injurious insects.

HOST PLANTS

The larvæ of this species normally feed within the stems of various species of Bidens. The writer has collected the borers from *Bidens frondosa* L., *B. cernua* L., *B. connata* Muhl. and *B. vulgata* Greene. It seems probable, therefore, that the larvæ will develop in still other species of this genus.

Overwintering larvæ of the bidens borer were also taken from stalks of *Ambrosia trifida* L., *Chenopodium album* L., *Solidago* spp., *Amaranthus retroflexus* L., *Polygonum* spp., *Typha* sp., and *Carex* sp., but in all cases it was quite evident that these plants were merely serving as shelter for larvæ that had wandered from their host and had then sought refuge in any suitable medium available. In one instance (in a plant of *Ambrosia trifida*) the presence of excrement indicated larval feeding had taken place but in all other cases the material in the burrow consisted of dry frass that had been ejected from the mouth.

Heinrich¹ lists *Bidens frondosa*, *Polygonum* and *Ambrosia* as food plants and it seems probable, therefore, that under certain conditions the borer breeds in plants other than *Bidens* spp.

* Journal Paper No. B41 of the Iowa Agricultural Experiment Station.

¹ Heinrich, C. Revision of the North American Moths of the Sub-family *Eucosminæ* of the family *Olethreutidæ*. U. S. N. M. Bull. 123, p. 154, 1923.

ECOLOGICAL CONSIDERATIONS

The bidens borer is quite naturally most abundant in low swampy areas and around lakes and streams where the *Bidens* plants are most abundant. It is not restricted, however, to these areas as many infestations have been found in *Bidens vulgata* on comparatively high and dry ground.

Moisture (rainfall) seems to be an important factor in inducing pupation of the overwintering larvæ. In the spring of 1927 a large number of *Bidens* plants containing borers were collected and divided into three lots. The first received normal rainfall; the second was protected from rain until June 20, when it was sprinkled with water and thereafter subjected to normal rainfall; and the third was kept dry until July 1. In the first case there was a normal emergence of moths beginning June 4, whereas in the second case pupation was greatly delayed, and emergence did not begin until July 9, and in the third case pupation did not occur. Toward the latter part of June most of the larvæ in this lot shriveled up and died. It should also be noted that no parasites issued from the third lot, whereas the first and second lots showed 62 and 54 per cent. parasitism, respectively.

On December 20, 1926, a number of larvæ were taken from plants that had been submerged in water and were frozen in the ice. In most cases water had entered the burrow and the borers were frozen in small cakes of clear ice. When this ice was melted and the larvæ gradually brought to room temperature they became active and crawled about in a normal manner. Early in February, larvæ taken from plants that had been submerged for about two months were alive and apparently healthy.

SEASONAL HISTORY

In Iowa the adults, developing from overwintering larvæ, begin to appear about the last of May and emergence continues until nearly the end of June. During the fore part of July the moths are usually scarce, but near the end of the month a second period of emergence begins and from that time until late in October the moths are always present. There are, however, two definite periods of maximum abundance. The first, which is the

largest, occupies the fore part of August, and the other occurs early in September. Thus, in the latitude of Iowa there appears to be three generations of *Epiblema otiosana* each year. One comes nearer stating the actual facts, however, by saying that there are two main broods and a small or partial third brood. Only the offspring from the moths emerging early in the season reach maturity in time to allow two broods to follow. At the same time it should be noted that the offspring of the last moths to emerge from the overwintering brood do not reach the adult stage until about the first of September and in this case there is barely time for the larvæ of the second generation to reach maturity in time to go into hibernation.

LIFE HISTORY AND HABITS

PUPA

There is nothing particularly distinctive about the pupa of this species. It is about one-half an inch, or slightly less, in length and varies according to age from light brown to chocolate brown in color. The abdominal segments are armed with transverse rows of minute spines which are used by the pupa in moving about in the burrow.

Pupation of the summer generations occurs within the stems of the *Bidens* plant. In the spring pupation occurs within the winter quarters of the larva.

The length of the pupal stage varies from 7 to 17 days and averages 11.2 days. As a rule pupæ of the overwintering brood and those of the second and third broods developing in September and October spend from 12 to 17 days in the pupal stage, whereas those of the summer broods spend only 8 or 9 days in this stage.

The overwintered larvæ normally pupate during late May and early June. The earliest recorded date for this brood was May 22, 1927, and the latest, June 29, 1927. Pupation of the first summer brood begins about July 20 and continues until late August; however, after the middle of August pupæ are always present in the field, and without knowing the history of the individual it is impossible to say whether it belongs to the first or second generation.

ADULTS

The adult is a small gray to grayish-black moth with characteristic white markings. It is about the size of a codling moth, which it somewhat resembles in shape and posture. As already mentioned the moths are practically always present during the summer months with periods of maximum abundance occurring in June, August and September.

The moths are nocturnal in habit, and during the day they remain hidden on the under side of leaves where they are seldom seen. When disturbed they are easily flushed and fly somewhat freely to the protection of another weed patch. Emergence occurs largely at night and mating usually takes place the first or second night following emergence. Egg deposition normally begins about dusk anywhere from the second to the fifth night after the emergence of the adult female. The oviposition period averages about 6 days in length and as a rule eggs are deposited each day during the period, with the greater number of eggs being deposited during the first two or three days. The largest number of eggs secured from a single female was 272 and the lowest 11. In captivity the moths nearly always laid less than 50 or more than 200 eggs, showing that the normal complement was between 200 and 250 eggs, but that for some reason about one-half of the moths refused to oviposit normally in cages; perhaps this also occurs in the field. The length of life for female moths was 9 to 18 days and for males 5 to 11 days. The males frequently died within 24 hours after mating.

EGG

The eggs are flat or scale-like, oval or elliptical in shape, and opaque white in color when laid. Within two days, however, they become somewhat transparent and two distinct red spots appear within each egg. The day before hatching the red spots vanish and the dark head of the now fully formed larva becomes the outstanding visible characteristic of the egg.

The eggs are deposited singly or in groups of two or three upon the leaves of the host plant. In the field about 75 per cent. of the eggs are laid on the underside of the leaves, whereas in cages they are deposited at random upon the sides of the cage and all parts of the plant.

The incubation period occupied from 4.5 to 15 days, depending upon the temperature. During the fore part of June, 1927, the eggs were exposed to a mean daily temperature of about 63° F. and required 15 days to hatch, whereas eggs deposited on July 9 of the same year received a mean daily temperature of approximately 80° F. and hatched in 4.5 days. Throughout the summer the mean temperature was about 74° F. and the average length of the incubation period was 6.1 days.

LARVA

The mature larva (Fig. 1) is about two-thirds of an inch long, yellowish-white in color and marked with fairly conspicuous

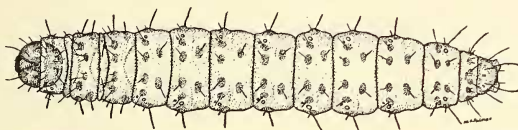


FIGURE 1. Mature larva of *Epiblema otiosana* (Clem.).

dark or blackish pinacula. Its head is amber or dark brown and the thoracic and anal shields yellowish-brown in color.

The number of larval instars varied from 5 to 7 but the majority of the larva completed development in 5 instars. Successive head capsule measurement (width) for larvæ having 5 instars were: 0.262 mm., 0.421 mm., 0.625 mm., 0.907 mm., and 1.30 mm. For those larvæ having more than 5 instars the head capsule width of the various instars was somewhat reduced. Variations in temperature from week to week produced marked variations in the length of the individual stadia and in the total length of the larval stage. In general, however, the first three or four stadia were about equal in length and the last two were somewhat longer than those preceding. The total length of the larval stage varied from 24 to 44 days and averaged 29.8 days. A glance at Table 1 will show the influence of temperature upon the length of the larval period. Larvæ hatching June 28, and July 7, 1929, were favored by normal July weather (72.9° F.) and reached maturity in 27 and 28 days respectively, whereas larvæ hatching July 22 and 31 encountered an unusually cool August (3.8° below average) and their larval period was extended to 33 and 36 days. Following the low temperatures in

TABLE 1
OBSERVATIONS ON THE LENGTH AND SEQUENCE OF LIFE CYCLES OF *Epiblema otiosana* (CLEM.) AT AMES, IOWA

Genera- tion	Date of egg depo- sition	Date eggs hatch	Egg stage (days)	Date of pupation	Larval stage (days)	Date adults emerged	Pupal stage (days)	Length of life cycle	No. aver- aged	
Over-winter				May 28, '26 Ju. 19, '26 May 22, '27 Ju. 10, '27 Ju. 29, '27 Ju. 3, '28		June 11 July 2-3 June 8 June 24-26 July 9-11 June 15-18	14.0 13.5 17 15 11 14 14.1		2 4 2 16 12 8	
Average ..										
First	June 19, '26 June 30, '26 July 10, '26 May 28, '27 June 21, '27 July 1, '27 July 16, '27 June 20, '28	June 29 July 6 July 16 June 8 June 28 July 7 July 22 June 28	10 6 6 12 7 6 6 7.6	July 23-27 Aug. 2-6 Aug. 11-15 July 12-19 July 21-28 Aug. 1-8 Aug. 20-29 July 23-30	26 27.5 26.9 38 27.2 28.1 33 27.1 29.2	Aug. 2-6 Aug. 10-17 Aug. 20-24 July 22-28 Aug. 1-8 Aug. 12-20 Aug. 29-S.9 Aug. 1-11	10 9.2 8.9 9.3 10.2 12.1 10.4 10.1 10.0	46 42.7 41.8 59.3 44.4 46.2 49.4 45.2 46.9	4 19 4 3 23 17 5 9	
Average ..										
Second	Aug. 11, '26 Aug. 22, '26 July 25, '27 Aug. 4, '27 Aug. 16, '27 Sept. 2, '27	Aug. 17 Aug. 28 July 31 Aug. 12 Aug. 25 Sept. 8	6 6 6 8 9 6 6.8	Sept. 2-9 Sept. 8-14 Sept. 18-24	36 29.2 26 30.4	Sept. 11-18 Sept. 17-22 Oct. 4-11		8.5 8.6 16.1 11.1	50.5 45.8 51.1 49.1	11* 7* 4* 4
Average ..										
Third	Sept. 3, '27	Sept. 18	5							

* Only partial pupation occurred. Some larvæ went into hibernation.

August came unseasonably warm days (mean daily temperature above 80° F.) in early September and the duration of the larval stage for larvæ hatching August 25 was reduced to 26 days.

Upon hatching, the young larvæ of the first generation enter the plant as leaf miners or as bud worms. After feeding for two or three days within the leaves or buds they migrate and burrow into the main stem or into one of the larger lateral branches. Feeding within the stem the larva spirals downward so that the spiral burrow practically girdles the plant and the top immediately wilts. Decomposition starts and moves steadily down the plant behind the advancing larva which is moving downward at the rate of from one to one and one-half inches per day. Usually the first plant (if a seedling) is killed within a week or ten days, whereupon the larva migrates to another plant. Young larvæ of the second and third generations feed for several days in the buds, blossoms or seed heads of the plant. The second or third instar larvæ migrate to the main stems and proceed downward as before. By this time, however, the plants are quite sturdy and the larva may feed for sometime before the plant is seriously injured.

In preparation for pupation the mature larva drops to the bottom of the burrow and partitions off the upper part of the burrow with a plug of silk and frass. It then prepares an exit hole for the resulting moth, just below the plug, by removing the woody parts of the stem and leaving only the epidermis of the stem intact.

NATURAL ENEMIES

Four species of Diptera: *Lixophaga variabilis* Coq., *Muscina stabulans* Fall., *Masicera senilis* Mg. and *Sarcophaga cimbicis* Tns., and six species of Hymenoptera: *Bassus simillimus* (Cress.), *Epiuris pterophori* (Ashm.), *Microbracon caulicola* Gahn., *Apanoteles harti* Vier., *Microbracon lutus* (Prov.) and *Macracentrus* sp. were reared as parasites from the larvæ of *Epiblema otiosana*. At times the combined efforts of these species resulted in seventy-five to eighty per cent parasitism of the borers collected in the field. It is of interest to note that several of the parasites of this borer are also the natural enemies of some other stalk borers including such destructive species as: *Papaipema nebris* (Gn.), *Pyrausta nubilalis* (Hubn.), and *Macronoctua onusta* Grote.